The University of Texas at Austin
Environmental Science Institute

Will We Live on Mars?

Lesson Plan for Grades: 6th – 8th
Length of Lesson: 60 minutes

Authored by: UT Environmental Science Institute
Date created: 03/23/2021

Subject area/course:

- Middle School Science (focus on Astronomy/Space and Earth Science)

Materials Per Group:

- Handouts: *Mission Components Packet, Mission Statement, Mission Components Worksheet*
- Posterboard
- Markers
- Glue sticks
- Scissors

TEKS/SEs:

§112.18. Science, Grade 6

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

- (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;
- (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.

(11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:

- (C) describe the history and future of space exploration, including the types of equipment and transportation needed for space travel.

§112.19. Science, Grade 7

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

- (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;

(9) Earth and space. The student knows components of our solar system. The student is expected to:

- (A) analyze the characteristics of objects in our solar system that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere; and
- (B) identify the accommodations, considering the characteristics of our solar system, that enabled manned space exploration.

§112.20. Science, Grade 8

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

- (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;

(8) Earth and space. The student knows characteristics of the universe. The student is expected to:

Will We Live on Mars?

- (D) research how scientific data are used as evidence to develop scientific theories to describe the origin of the universe.

Lesson objective(s):

- Students will collaborate to develop their own mission to Mars and use critical thinking skills to create a mission to Mars that fits the constraints given to them.
- Students will further develop their critical thinking skills and come to their own conclusions about Mars missions.
- Students will be able to analyze data presented and decided if an area is a good landing site.

Differentiation strategies to meet diverse learner needs:

- The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills.
- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration.

ENGAGEMENT (10 minutes)

- The teacher will start the lesson by displaying a picture of Mars taken from the Mars 2020 Perseverance rover (see *Engagement Handout*).
- Students will do a think-share-pair exercise. Students will be given 2 minutes to analyze the picture and think about the following questions. The questions can be written, displayed on the board or just spoken aloud.
  - *Where do you think this picture was taken?*
  - *What are some geological features you notice in the picture?*
  - *Is there anything that stands out to you about the picture?*
  - *Is this some place you would want to visit?*
- Once the students have thought about it individually, the teacher will pair the students up. Students will be provided an additional 3 minutes to discuss the image and the questions with their assigned partner.
- After 3 minutes, the teacher will reconvene the class and start a whole class discussion. The teacher will randomly call on different pairs of students to ask them what they think and noticed about the image. The teacher will guide the conversation and focus on how the image easily looks like it could have been taken on earth.
- Additional questions the teacher can ask:
  - *When do you think these geological features were formed?*
  - *What do you notice about the coloration of the photo? What does the overall coloration potentially tell us about the environment or time of day?*
  - If the students think it's on earth, ask them *"Is it possible for the image to on another planet?"*
  - The teacher should further question whether students would want to visit the area in the photo now that they know it was taken on Mars instead of Earth. Teacher should take note of which students seem excited about the prospect or more hesitant.
- Once the teacher feels like a good discussion has occurred, they can inform the students that the picture shown is a picture of Mars taken during a recent mission.

Transition: "I know some of you were excited about the prospect of visiting Mars, and while we can't go to Mars yet, you are going to be given the opportunity to plan a mission to Mars."

Will We Live on Mars?

EXPLORATION (30 minutes)

- Teacher: "I will divide you into groups of 3 or 4. As a group you are going to plan out everything you will need for a mission to Mars."
- The teacher will pass out the following to each group:
  - The *Mission Components Packet* listing the components available to plan their mission.
  - A *Mission Statement Handout* with the specific mission requirements for each group.
  - A *Mission Components Worksheet* to help each group keep their mission within their constraints.
  - Poster board, markers, scissors, and glue sticks to create the poster.
- Teacher: "Each group will work together to plan a mission to Mars. The *Mission Components Packet* lists different materials. Depending on your mission requirements, which are listed on your *Mission Statement Handout*, you will select the components (cards) that you want to use for your mission. Fill out the *Mission Components Worksheet* to keep your mission within your constraints. Once you select the different components you will use, cut out the appropriate cards and design your team poster. Your group poster should include:
  - Mission goal, length and budget (from the *Mission Statement Handout)*
  - *Mission Component Cards* with the components your team selected
  - Mission constraints (from the *Mission Statement Handout)* or other clarifying information your group wishes to share about your plan to Mars
- Teacher: "Organize your poster any way you want. Each team has 20 minutes to complete this activity. Please carefully read through all the handouts before you start. I will walk around and observing so feel free to ask me any additional questions that you may have."
- As the students are working the teacher will be walking around listening to the students' conversations, making note of any interesting comments made, paying attention to any misconceptions, and answering additional questions as they arise.

Transition: "From walking around I can see you have created some great missions to Mars. I want to give everyone the chance to see what you guys created."

EXPLANATION (10 minutes)

- The students will do a gallery walk to learn about the different missions.
- For each team, one team member will stay with their poster to explain their mission and their decisions to the rest of the students. The teacher will split up the 8-minute explanation period, rotating each group's presenter with a new team member.
- Throughout the 8 minutes the students that are not presenting their posters will be walking around stopping at different posters at random and asking the presenters questions about their mission.
- The teacher will be walking around participating in the gallery walk, as well as maintain order by ensuring that the students are actively rotating between the different posterboards.
- The teacher reconvenes the class and asks students to share something they saw in the gallery walk.

Transition: "Now that planned our missions to Mars we need to decide where we're going to land."

ELABORATION (10 minutes)

- The teacher will now pass out the *Elaboration Student Handout* (listed below).
- Teacher: "We spent a lot of time and money planning our missions. To successfully land on Mars, we need to pick the perfect landing spot. I want each of your groups to decide where

Will We Live on Mars?

your Mars mission should land. Be prepared to share and defend your landing site choice with the class. You'll be given 7 minutes to complete this activity so get started."

- The teacher will be monitoring the students as they work and once the 7 minutes are up the teacher will randomly call on groups to share what landing site they chose.
- Questions the teacher may ask to help the students explain their justification.
    - Why would you rather land in a low elevation site instead of a higher elevation site?
    - Why does it matter how deep underground the potential ground water is?
    - What was the most important factor you looked at in order to determine which site you should pick?
    - Why is the potential for past life another important factor to consider?
    - What are some of the consequences of choosing the wrong landing site?

EVALUATION (throughout entire lesson)

- Evaluation will be conducted throughout the entire lesson, as the students are discussing their work amongst themselves the teacher will be walking around assessing the student's conversations, making note of any misconceptions and interesting points.
- The teacher will ensure that all the students are actively working and that both individuals in the pair are contributing to their group's success.
- After each activity, the teacher will collect the handouts and assess their contents.

SOURCES AND RESOURCES

- **Dr. Joe Levy's *Hot Science At Home* #1.4 "Will we live on Mars"** https://www.esi.utexas.edu/talk/will-we-live-on-mars/
- **NASA: Mars 2020 Mission Perseverance Rover,** https://mars.nasa.gov/mars2020/
- **NASA: Mars Exploration Program,** https://mars.nasa.gov/
- **NASA: Mars Exploration Program, Engagement Handout** https://mars.nasa.gov/resources/25674/perseverances-mastcam-z-first-high-resolution-panorama/
- **Image Sources:**
    - Engagement Handout: **NASA**: **Mars Exploration Program,** https://mars.nasa.gov/resources/25674/perseverances-mastcam-z-first-high-resolution-panorama/
    - [1] "The Israeli-designed Shavit space rocket." by IsraelMFA is licensed under CC BY-NC 2.0
    - [2] "U S Space & Rocket Center, Huntsville AL 04" by Larry Miller is licensed under CC BY-NC-ND 2.0
    - [3] "'Two Sides' of LRO/LCROSS (NASA, Moon, 6/17/09)" by NASA's Marshall Space Flight Center is licensed under CC BY-NC-ND 2.0
    - [4] "Solar Panels" by Chandra Marsono is licensed under CC BY-NC-SA 2.0
    - [5] "Apollo Fuel Cell Number 1" by jurvetson is licensed under CC BY 2.0
    - [6]"Mars Science Lab power source" by Idaho National Laboratory is licensed under CC BY 2.0
    - [7] "Solar Panel Battery Enclosure on Traffic Light" by Dave Dugdale is licensed under CC BY-SA 2.0
    - [8] "A Real Camera" by hyfen is licensed under CC BY-NC-SA 2.0
    - [9] "NASA Infrared Image Shows Sandy's Center Nearing U.S. East Coast" by NASA Goddard Photo and Video is licensed under CC BY 2.0
    - [10] "Radiation Sensors on Tripod-tower" by ARM Climate Research Facility is licensed under CC BY-NC-SA 2.0
    - [11] "RDECOM's Advanced Chemistry Laboratory is on the forefront of scienceACL - flickr 5-2012-0902" by U.S. Army Combat Capabilities Development Command is licensed under CC BY 2.0
    - [12] "think outside the box" by Sean MacEntee is licensed under CC BY 2.0

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- [13] "Hellespontus Montes topography" by europeanspaceagency is licensed under CC BY-SA 2.0
- [14] "Wind Sensor - Southern Great Plains" by ARM Climate Research Facility is licensed under CC BY-NC-SA 2.0
- [15] "Picturing the Sun's Magnetic Field" by NASA Goddard Photo and Video is licensed under CC BY 2.0
- [16] "Parker Solar Probe Prelaunch (NHQ201808110005)" by NASA HQ PHOTO is licensed under CC BY-NC-ND 2.0
- [17] "STS-85 (97pc1009KSC)" by NASAKennedy is licensed under CC BY-NC 2.0
- [18] "SR 99 tunnel crews drilling to look for obstruction" by WSDOT is licensed under CC BY-NC-ND 2.0
- [19] "17-Apollo 17 CM Heat Shield" by jotulloch is licensed under CC BY-NC-SA 2.0
- [20] "Success! Ares I Rocket Parachute Test (NASA, 5/20/09)" by NASA's Marshall Space Flight Center is licensed under CC BY-NC-ND 2.0
- [21] "Epic Cluster Rocket Launch" by jurvetson is licensed under CC BY 2.0
- [22] "Up it goes! Airbags do the job" by WSDOT is licensed under CC BY-NC-ND 2.0
- [23] "Sony Playstation 2 SCPH-5001 V9 - Memory Card de 8mb (verso) / 8mb Memory card (back) - SCPH-10020" by Deni Williams is licensed under CC BY 2.0
- [24] "Microprocessor Intel 486DX Pins" by Dalo-Pix is licensed under CC BY-NC 2.0
- [25] "Microprocessor" by jcubic is licensed under CC BY-SA 2.0
- [26] "Main Computer 4790 build 8-14" by THE Holy Hand Grenade! is licensed under CC BY-ND 2.0
- [27] "broadcast antenna" by HerPhotographer is licensed under CC BY-NC-SA 2.0
- [28] https://mars.nasa.gov/mars2020/spacecraft/instruments/
- [29] https://mars.nasa.gov/technology/helicopter/#Overview
- [30] "camping tent" by baylina is licensed under CC BY-NC 2.0
- [31] "Our dome tents at Base Camp" by markhorrell is licensed under CC BY-NC-SA 2.0
- [32] "Our storage and dome tents nestle beneath Everest" by markhorrell is licensed under CC BY-NC-SA 2.0
- [33] "Orbital Protection Shield" by reassembling.visions is licensed under CC BY-NC 2.0
- [34] https://mars.nasa.gov/mars2020/spacecraft/instruments/moxie/
- [35]"DSC03243 - Generator" by archer10 (Dennis) is licensed under CC BY-SA 2.0

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Engagement Handout

Image Source

2275 Speedway, C9000 | Austin, TX 78712 | 512.232.4558 | esi.utexas.edu

Will We Live on Mars?

EXPLORATION: MARS MISSION COMPONENTS PACKET

Based on your *Mission Statement*, use the following component cards to plan your Mars mission. Pay attention to the cost, weight, and power supply when choosing your items.

Mission Components Available

- Rocket types (orange cards)
- Power supply sources (yellow cards)
- Scientific equipment for exploration and analysis (blue cards)
- Landing gear (green cards)
- Essential equipment (gray cards)
- Rovers (red cards)
- Human resources (purple cards)

MU = weight/mass units
EC = electricity/power
$ = equipment cost

Instructions

- Keep your mission constraints in mind when selecting your components.
    - Your budget is listed on your *Mission Statement Handout.*
    - Your weight constraint depends on which rocket you choose. *Ex: If you choose a light lift rocket your weight limit is 140 mass units (MU).*
    - Your energy constraint depends on the energy source you select. *Ex: if you choose medium power solar panels your energy constraint is 50.*
- Your team can only choose one rocket, one energy source, and one rover (unless otherwise specified in the *Mission Statement)*. If your team chooses solar energy as a source, you will need the on-board battery as well.
- For all the other components, you can choose more than one option if your constraints allow.
- Read through all the component cards. Components with **red text** are either requirements for all missions or paired with something else.
- As you are selecting your components keep track of how much each component costs, weighs, and how much energy it uses. Make sure your totals do not exceed any constraints. If they do, remove items and recalculate.

Will We Live on Mars?

Mission Components: Rocket Types

Light Lift Rocket 1[1]	Medium Lift Rocket 2 [1]
 **Carrying Capacity: 140 mass units (MU)** Medium Risk: works 4 times out of 6 **$120M**	 **Carrying Capacity: 160 mass units (MU)** Low risk: works 5 times out of 6 **$120M**
Heavy Lift Rocket 1[2]	**Heavy Lift Rocket 2[2]**
 **Carrying Capacity: 180 mass units (MU)** High risk: works 3 times out of 6 **$200M**	 **Carrying Capacity: 200 mass units (MU)** Medium Risk: works 4 times out of 6 **$200M**
Rocket Nose Cone [3]	
 **Required for all space missions** Protects your spacecraft during launch **$15M** **MU: 10**	

Will We Live on Mars?

Mission Components: Power Supply

Medium Power Solar Panel [4]

Amount of power generated: 50
Lasts a few years; needs sunlight
Only works during day and near the equator

$40M **MU: 15**

High Power Solar Panel [4]

Amount of power generated: 80
Lasts a few years; needs sunlight
Only works during day and near the equator

$50M **MU: 20**

Fuel Cell [5]

Amount of power generated: 70
Lasts a few months; works everywhere
Does not need the sun or a battery

$80M **MU: 25**

Radioisotope Power System [6]

Amount of power generated: 100
Lasts over a decade; works everywhere
Does not need sun or battery

$100M **MU: 30**

On Board Battery [7]

A battery is required for all solar powered missions
Stores power collected by solar panels

$20M **MU: 10** **EC: 2**

Will We Live on Mars?

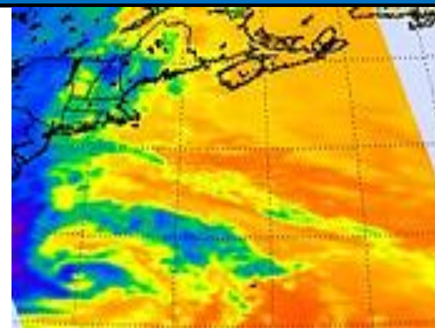
Mission Components: Scientific Equipment for Exploration and Analysis

High Resolution Camera [8]

Takes detailed images of landscapes
Has a limited range

$15M **MU: 2** **EC: 4**

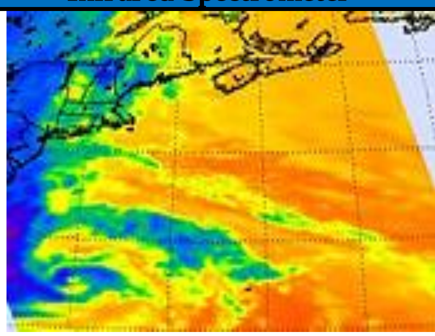
Infrared Camera [9]



Provides basic information about minerals and grain size of the soil

$25M **MU: 3** **EC: 2**

Infrared Spectrometer [9]



Detects minerals in detail, including those formed in water
Helps discover if there was past life

$25M **MU: 4** **EC: 2**

Radiation Sensor [10]

Discovers if Mars is suitable for human habitation
Shows places where radiation is lower

$30M **MU: 4** **EC: 3**

Life Science Laboratory [11]

Requires sample collection device
Discovers signs of life past or present

$60M **MU: 20** **EC: 15**

Sample Collection Device [12]

Required for Life Sciences Laboratory
Collects air, rocks, and soil samples

$5M **MU: 3** **EC: 1**

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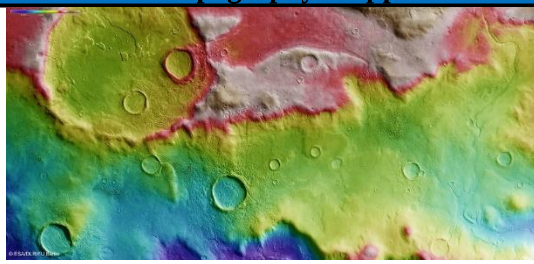
Mission Components: Scientific Equipment for Exploration and Analysis

Laser Topography Mapper [13]



Measures high and low points on the Martian terrain

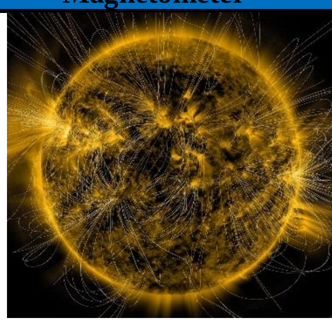
$30M **MU: 4** **EC: 2**

Mars Environmental Dynamics Analyzer [14]

Collects detailed data about wind speeds and chemicals in the atmosphere

$20M **MU: 5** **EC: 2**

Magnetometer [15]



Measures where Mars has a magnetic field which can protect life from radiation

$20M **MU: 5** **EC: 2**

Impact Probe [16]

Penetrates Martian surface at high speeds to collected data below the surface

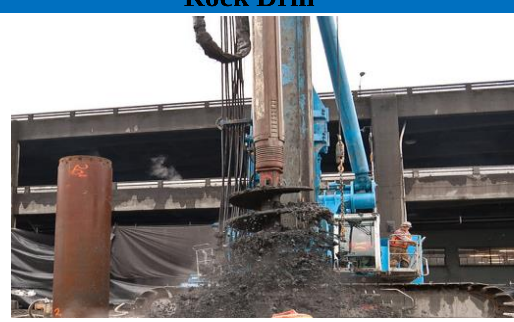
$30M **MU: 15** **EC: 0**

High Energy Spectrometer [17]

Helps show where on Mars has water
Helps discover if Mars had past life

$25M **MU: 5** **EC: 5**

Rock Drill [18]



Collects samples by drilling into rocks
Drills for subsurface water

$25M **MU: 15** **EC: 5**

Will We Live on Mars?

Mission Components: Landing Gear

<table>
<tr><th>Heat Shield [19]</th><th>Hypersonic Parachute [20]</th></tr>
<tr><td>
Required to protect all spacecrafts traveling through atmosphere and space
$15M **MU: 12** **EC: 0**</td><td>
Required for all Mars landers
Slows spacecraft down before use of airbags or rockets
$15M **MU: 8** **EC: 0**</td></tr>
<tr><th>Retro-Rockets [21]</th><th>Airbags [22]</th></tr>
<tr><td>
Either airbags or Retro-Rockets
Slows spacecraft down for a controlled landing
Spacecraft can be damaged on rocky terrain
$30M **MU: 8** **EC: 0**</td><td>
Either airbags or retro-rockets
Protects spacecraft from impact
Precise landings are difficult
$20M **MU: 6** **EC: 0**</td></tr>
</table>

Will We Live on Mars?

Mission Components: Essential Equipment

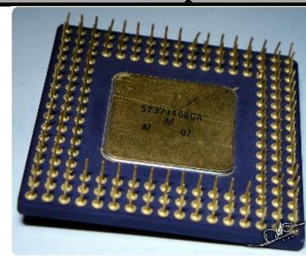
Main Memory Card [23]

Required for all missions

Stores data until it can be sent back to earth

$10M **MU: 1** **EC: 3**

Standard Microprocessor [24]

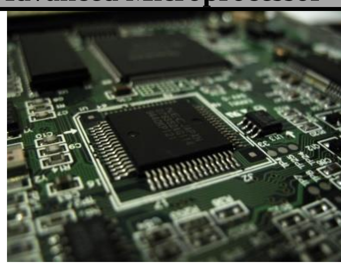


At least one is required for all missions

Provides mission brainpower

$12M **MU: 1** **EC: 1**

Advanced Microprocessor [25]



At least one is required for all missions

More brainpower programmed to complete simple commands

$15M **MU: 1** **EC: 2**

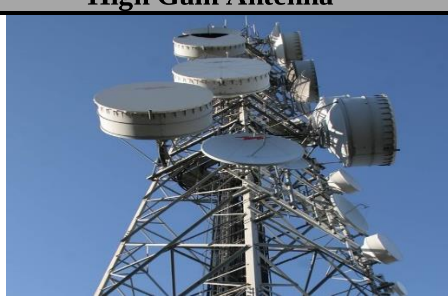
Main Bus [26]

Required for all missions

Connects all the scientific equipment to the onboard computer

$35M **MU: 5** **EC: 5**

High Gain Antenna [27]



Required to communicate with Earth

Sends large amounts of data at a time

$10M **MU: 2** **EC: 3**

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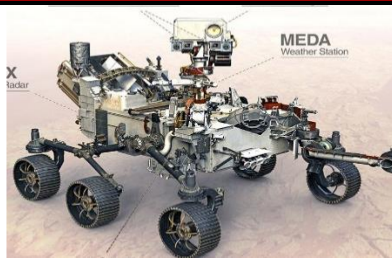
Mission Components: Rovers

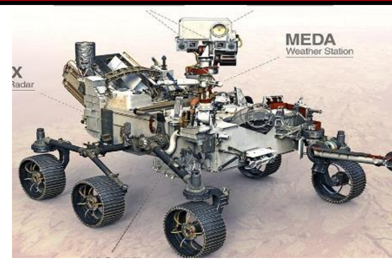
Mars Rover 1 [28]



Daily maximum travel distance: 20km
Can only be equipped with a high-resolution camera

$40M **MU: 15** **EC: 10**

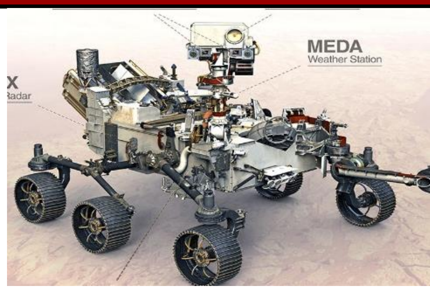
Mars Rover 2 [28]



Daily maximum travel distance: 25km
Can only be equipped with a high-resolution camera

$45M **MU: 15** **EC: 12**

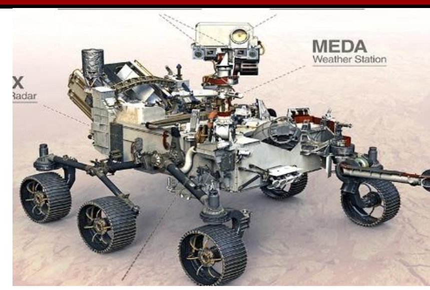
Mars Rover 3 [28]



Daily maximum travel distance: 50km
Can be equipped with any camera or spectrometer

$50M **MU: 20** **EC: 20**

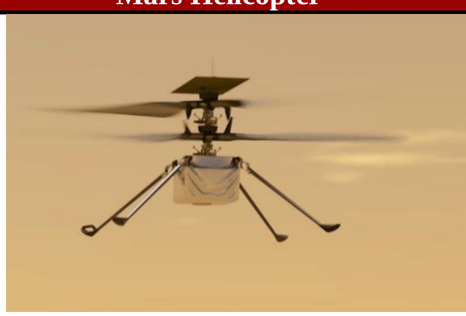
Mars Rover 4 [28]



Daily maximum travel distance: 65km
Can be equipped with any camera, spectrometer, and can collect samples

$60M **MU: 25** **EC: 20**

Mars Helicopter [29]



Daily maximum travel distance: 90km
Can be equipped with any camera or spectrometer

$80M **MU: 15** **EC: 30**

Will We Live on Mars?

Mission Components: Human Resources

On Site Shelter 1[30]

Protects the astronauts from the elements
Can house a maximum of 4 people
Outfitted to last for 4 months

$40M **MU: 20** **EC: 0**

On Site Shelter 2[31]

Protects the astronauts from the elements
Can house a maximum of 6 people
Outfitted to last for 6 months

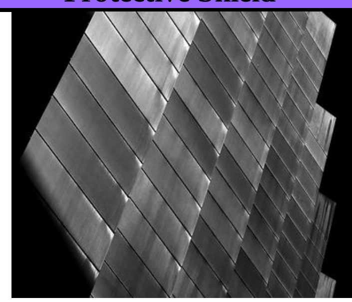
$60M **MU: 25** **EC: 0**

On Site Shelter 3[32]

Protects the astronauts from the elements
Can house a maximum of 8 people
Outfitted to last for 12 months

$80M **MU: 30** **EC: 0**

Protective Shield[33]



Required for all missions
Protects our astronauts from solar and magnetic radiation

$30M **MU: 12** **EC: 2**

Mars Oxygen ISRU Experiment[34]

Required for all missions
Produces oxygen from Mars' mostly carbon dioxide atmosphere

$55M **MU: 6** **EC: 4**

Atmospheric Water Generator[35]

Required for all missions
Extracts water from the atmosphere
Provides a water source until one is found

$50M **MU: 8** **EC: 6**

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EXPLORATION: MISSION STATEMENT HANDOUT

Names: ______________________________ Date: ______________

____

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Mars Mission 1

Using the *Mars Mission Components Packet*, your team needs to plan out a Mars mission based on the goal and constraints listed below.

Once you have chosen all your components, cut out the cards from the packet to create the poster. Your team will then create a poster with the following information:

- Mission goal, length and budget (found in the *Mission Statement Handout)*
- *Mission Component Cards* from the materials you selected
- Mission constraints (also found in the *Mission Statement Handout),* or other clarifying information your group wishes to share about your plan to Mars

You will share your poster with the rest of the class so it should be readable and creative.

- Mission Goal: Your mission will focus on searching for water on the Martian terrain. The end goal is for humans to be able to one day live on Mars but in order for that to happen there needs to be a steady source of accessible water.

- Length of Mission: This mission is extremely important for any future Mars explorations as a result you group has 6 months on site to search for water.

- Budget Constraints: $500 million

- Specific Requirements: Since we might be looking for water potentially below the Martian surface you are required to bring the ***impact probe*** as well as a ***rock drill***. We have chosen your mission to test out some new solar panels. You are required to choose ***one of the solar panels*** as your source of energy.

Will We Live on Mars?

EXPLORATION: MISSION STATEMENT HANDOUT

Names: ___________________________ Date: ____________

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Mars Mission 2

Using the *Mars Mission Components Packet*, your team needs to plan out a Mars mission based on the goal and constraints listed below.

Once you have chosen all your components, cut out the cards from the packet to create the poster. Your team will then create a poster with the following information:

- Mission goal, length and budget (found in the *Mission Statement Handout)*
- *Mission Component Cards* from the materials you selected
- Mission constraints (also found in the *Mission Statement Handout),* or other clarifying information your group wishes to share about your plan to Mars

You will share your poster with the rest of the class so it should be readable and creative.

- Mission Goal: Your mission will focus on studying the geological features found on Mars. You will be studying mountains, craters, valleys and any other prominent land features within your area. Your research will be critical in helping chose a future site for human habitation.

- Length of Mission: Due to various governmental constraints, you only have 4 months on site to study the geological features found on Mars.

- Budget Constraints: $770 million

- Specific Requirements: To cover a larger surface area, you will need to take the ***Mars Helicopter*** as well as a ***Mars Rover***. Since the main focus of your Mars mission is studying the geological features, your landing must as precise as possible so **retrorockets** should be included in your planning.

The University of Texas at Austin
Environmental Science Institute

Will We Live on Mars?

EXPLORATION: MISSION STATEMENT HANDOUT
Names: ___________________________ Date: ____________

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Mars Mission 3

Using the *Mars Mission Components Packet*, your team needs to plan out a Mars mission based on the goal and constraints listed below.

Once you have chosen all your components, cut out the cards from the packet to create the poster. Your team will then create a poster with the following information:

- Mission goal, length and budget (found in the *Mission Statement Handout)*
- *Mission Component Cards* from the materials you selected
- Mission constraints (also found in the *Mission Statement Handout),* or other clarifying information your group wishes to share about your plan to Mars

You will share your poster with the rest of the class so it should be readable and creative.

- Mission Goal: Your mission will focus on searching for signs of life (either past or present) on Mars. The presence of life on Mars either would be the perfect indicator for whether or not humans will be able to one day call Mars home.

- Length of Mission: Due to a variety of constraints, NASA has only allowed your group only 3 months to complete your mission. During your mission you will need to collect plenty of samples and bring them back to Earth for further study.

- Budget Constraints: $800 million

- Specific Requirements: None

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Will We Live on Mars?

EXPLORATION: MISSION STATEMENT HANDOUT

Names: ___________________________ Date: ____________

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Mars Mission 4

Using the *Mars Mission Components Packet*, your team needs to plan out a Mars mission based on the goal and constraints listed below.

Once you have chosen all your components, cut out the cards from the packet to create the poster. Your team will then create a poster with the following information:

- Mission goal, length and budget (found in the *Mission Statement Handout)*
- *Mission Component Cards* from the materials you selected
- Mission constraints (also found in the *Mission Statement Handout),* or other clarifying information your group wishes to share about your plan to Mars

You will share your poster with the rest of the class so it should be readable and creative.

- Mission Goal: Your mission will focus on deciding the outpost/landing site for all Mars missions in the foreseeable future. Your team needs to explore a vast amount of terrain looking for sites with access to water, navigable terrain, will be safe for humans to stay in for an extend period of time, and is prime location for any future explorations that may take place.

- Length of Mission: We are asking a lot of your team for this mission, as a result, we are giving you a full year on Mars to explore and conduct as much research as you can.

- Budget Constraints: $900 million

- Specific Requirements: To cover a larger surface area, you will need to take a ***Mars Helicopter*** in addition to a ***Mars Rover***. To ensure your team will have enough electricity (for your current mission and future missions that may land at the outpost you create), you are required to take the ***radioisotope power system***.

Will We Live on Mars?

EXPLORATION: MISSON COMPONENTS WORKSHEET

Budget Constraints: _________________ (on *Mission Statement Handout*)

Weight Constraints: __________________ (Carrying Capacity of your rocket: MU)

Energy Constraints: __________________ (Amount of Power Generated by energy source EC)

Do not let your totals exceed your constraints!

Mission Component	Cost: $	Mass Units: MU	Energy Used: EC
Rocket Nose Cone (required for all missions)	15	10	0

Will We Live on Mars?

EXPLORATION: MISSON COMPONENTS WORKSHEET (continued)

Mission Component	Cost: $	Mass Units: MU	Energy Used: EC
Total			

Did you have to make any changes to your original plan due to your constraints?

Are there any additional resources you want to take on your mission but cannot take due to your constraints?

Will We Live on Mars?

ELABORATION: STUDENT HANDOUT

The Perfect Spot?

Your group must find the perfect landing spot for our astronauts. Use the information below to decided which landing site would be the most ideal. Remember landing on Mars is one of the hardest parts of the entire mission. The wrong choice can prematurely end the mission. Be prepared to defend your landing site choice.

The following table describes potential landing sites NASA has proposed for the Mars 2028 mission. Your team needs to review the information listed in the table and decide where the astronauts will be landing. The first three columns use a 0 to 10 scale. 0 means there is no potential and 10 means there is the greatest potential.

Site Name	Potential for past habitation	Potential for organic matter with surface exposure	Potential for interpreting relative ages	Near surface ice, glacial or permafrost	How far water is potentially underground (meters)	Located in the northern hemisphere	Elevation (meters)
Melas Chasma	7	5	8	Yes	2m	Yes	200m
Gale Crater	5	2	9	No	3m	No	500m
Hebrus Valles	7	5	4	Yes	1m	Yes	250m
Kasei Valles	7	6	7	Yes	2m	Yes	180m
Noctis Landing	3	6	4	Yes	4m	No	600m
Aram Chaos	4	7	6	No	3m	Yes	420m

Which landing site did you choose and why?

Disclaimer: The site names are actual sites found on Mars but all the information found in the table is not accurate.